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APPLIED ANIMAL  
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Applied Animal Behaviour Science xxx (2007) xxx–xxx

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# The relationship between number of training sessions per week and learning in dogs

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Accepted 20 June 2007

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## Abstract

Despite the fact that most domestic dogs receive some kind of training, surprisingly few studies have been undertaken to analyze the process in detail, e.g. the question of how often training should be done has not been investigated in dogs. According to the Danish animal protection law, laboratory animals, including laboratory dogs, must be habituated to personnel and laboratory procedures before experimentation. In order for the law to be implemented, however, better knowledge about the effect of different training schedules on the learning performance of dogs is needed, something that is also of interest for owners and trainers of family dogs as well as working type dogs. The purpose of the present study was to investigate the effect of two different training schedules on the number of training sessions required to reach a certain training level. Using shaping and clicker training, 18 laboratory Beagles were trained to perform a target response. Nine dogs were trained once a week and nine dogs were trained five times a week. The results of the study show that dogs trained once a week learned the shaping exercise in significantly fewer training sessions than dogs trained five times a week. In addition, weekly trained dogs tended to have higher success rates at the different steps of the shaping exercise than the dogs trained five times a week. The dogs trained five times a week completed the shaping exercise in significantly fewer days than the weekly trained dogs. It is concluded that for dogs learning a given skill, weekly training results in better learning performance than training five times a week, when performance is measured in the number of training sessions required to reach a certain training level.

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*Keywords:* Learning; Training; Dogs; Temporal distribution

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## 1. Introduction

Despite the fact that most domestic dogs (*Canis lupus familiaris*) undergo some degree of training, surprisingly few scientific studies have analyzed the training process systematically. One aspect of training that has been particularly neglected is the question of how often training should be done. Detailed information on or guidelines to the optimal temporal distribution of training sessions is hard to find in the wide range of popular literature on dog training. Concerning structured training sessions, some authors suggest that each skill should be trained once to several times a day depending on the difficulty of the skill (e.g. Abrantes, 2000; Bailey, 1995), and some authors emphasize the importance of training in increasingly more disturbing environments and training more than one skill at a time (e.g. Egtved and Køste, 2005).

One obvious reason for the limited amount of research on dog training is that most dogs are privately owned and therefore kept and handled in vastly different ways, so that a direct comparison of different methods using a sufficiently large number of dogs is not possible. In the pharmaceutical industry, however, dogs are often used as laboratory animals. They are kept in large numbers under fairly standardized conditions, thus constituting an excellent animal material for systematic studies. In addition, to comply with the Danish laboratory animal protection law, laboratory dogs must be habituated to the personnel and to the experimental conditions, not only to increase the welfare of the dogs (Morton, 2004) but also to assure better results from the experiments. Socializing the dogs to humans, giving them basic training, and training them for special testing procedures, such as standing still for blood collection, is time consuming and necessitates extra personnel. In a survey on the use of training in establishments using non-human primates as laboratory animals, it was demonstrated that even though there is general awareness of the benefits of training, it is not very widespread, partly due to a perceived overestimation of the time investment needed (Prescott et al., 2005). To optimize both the economy and the welfare of laboratory dogs it is thus of interest to know how much time needs to be put into training and, perhaps more important, what kind of training schedule is the most efficient.

Research on the effects of different training schedules in other species often involves massed versus spaced training. Comparing these training schedules, spaced training appears to result in better learning in terms of acquisition and retention. When training is spaced, rats in the Morris Water Maze acquire the task of escaping onto a platform faster, and they obtain a better spatial memory (Commins et al., 2003). The positive effect of spaced training on long-term spatial memory in rats has also been shown by Spreng et al. (2002). Horses learning an avoidance response achieve a given learning criterion in significantly fewer training sessions when trained once a week compared to horses trained every day (Rubin et al., 1980). The opposite has been demonstrated in a study of yearling horses trained to trot with a rider on a track. This study showed a tendency towards daily training being more effective than training schedules with longer resting periods interposed (Kusunose and Yamanobe, 2002). In an experiment on fear reduction in human subjects, a variation of the spaced training schedule was compared to massed training. An expanding-spaced exposure to a fear eliciting stimulus prevented return of fear in the subject, whereas a massed exposure schedule resulted in better fear reduction, but also in return of fear at a follow up assessment (Rowe and Craske, 1998). The purpose of the present study was to investigate whether the number of training sessions per week affects the number of training sessions required to reach a certain training level in laboratory dogs.

## 2. Method

The design of the experiment in the present study is a parallel group design. Eighteen dogs were divided into two groups. Dogs in the first group were trained once a week, while dogs in the second group were trained 5 days a week, Monday–Friday.

### 2.1. Subjects

Eighteen dogs from a population of laboratory Beagles, used for kinetic analysis, were used as subjects. The dogs were randomly selected and divided into two groups by the personnel. Each group consisted of five males and four females, ages 1–3 years. Dogs were housed in pens singly or in pairs, with two pens sharing a small outdoor kennel. Dogs sharing a small kennel were divided into the two groups; consequently the groups were comparable in regards to gender, age and housing.

### 2.2. Training

#### 2.2.1. General principles and initial training

All dogs were trained by the same person. All training took place in a room that initially was unfamiliar to the dogs. The training room was in another building than the housing facilities. The dogs were led on a leash to the training room and returned to their pen one at a time. Training was carried out during the day, when the dogs were used to activities in their environment. Preferably the dogs were trained before they were fed. When this was not possible, the dogs were trained as late after the feeding as possible. All dogs showed interest in the food during training.

As an introduction to a clicker and the training room, all dogs were given one session on two separate days before the training of the shaping exercise started. During these sessions classical conditioning was used to condition the clicker. Pellets of the dogs' ordinary diet were used as reinforcers and will be designated as treats. By the end of the two preliminary training sessions, all dogs reacted to the sound of the clicker by looking at the trainer in anticipation of a treat. During this training care was taken not to reinforce any specific behavior. Instead the presentation of *click + treat* was timed on as many variable behaviors as possible, but not on unwanted behavior. The same clicker was used for all trials in this study.

All further training was based on operant conditioning, using the conditioned positive reinforcer *click*, for marking correct responses, followed by the unconditioned positive reinforcer *treat*. *Jackpots*, consisting of more than one treat, were used when the response of a dog exceeded the expectations at that point in the training. The sound-signal *no*, which the dogs knew from routine training performed by the personnel, was used to stop unwanted behavior. If training was obstructed by poor concentration in the dogs, time-outs were used as negative punishment. The trainer turned her back on the dogs until they willingly jumped on the table and showed interest in the training again.

#### 2.2.2. The shaping exercise

During training the dogs were placed on a table approximately 40 cm above ground. The desired learning objective was for the dog to mark with a front paw on a mouse pad placed approximately 1 m away from the trainer. This task was chosen because it was unlike anything, the dogs were learning at the time, and because it was easy to divide into well defined steps in order to create a standardized shaping task. The dogs had to pass one step before moving on to the next.

When a dog performed 80% or more correct responses at a given training step it moved on to the next step during the following training session. On the other hand, if a dog performed with less than 20% correct responses at a given training step, it went back to the previous step on the following training session, until it achieved at least 80% correct responses again at this step. Every training session started with three preliminary trials at the step on which the dog was last trained. If a dog was proposed to move on to a new step, it had to respond correctly on at least one out of the three preliminary trials. If the dog did not give a

Table 1

Criteria for success in the four steps 0–3

Step	Criteria for correct responses
0	The dog shows interest in the pad by sniffing, stroking or touching the pad in some way
1	The dog touches the pad with a front paw, when the pad is held in front of the dog
2	The dog touches the pad with a front paw when the pad is laid down in front of the dog
3	The pad is placed at the other end of the table on which the dog stands. The dog walks away from the trainer to the pad and touches it with a front paw

correct response on the preliminary trials it would continue training at the previous training step until again it achieved 80% correct responses at that step.

The exercise was divided into four steps, step 0–3. In order to standardize the training as much as possible, detailed descriptions of each step were put in writing. Table 1 summarizes the criteria for correct responses in the four steps. The mouse pad was blue and measured 15 cm × 15 cm. The same pad was used throughout the study.

Some dogs readily lifted their front paws when a person reached out a hand to them, others did not lift their paws at all. With the intention of equalizing differences in the behavioural repertoire of the dogs, all dogs were taught to “shake hands” (lifting a front paw in response to a hand held in front of the dog), when they had passed step 0. This was done in continuation of the last training session at step 0 by holding a treat in a closed hand in front of the nose of the dog. When the dog pawed the hand to get the treat it was reinforced with a click and the hand opened to reveal the treat. When a dog lifted a paw three times in a row in response to the trainer holding up a hand in front of it, it was considered ready to move on. On the following training session the dog proceeded at step 1.

### 2.2.3. The training schedule

The two groups of dogs were trained with different intervals between training sessions. Group 1 was trained once a week with 6–8 days between training sessions. Group 2 was trained five times a week, with approximately 24 h between training sessions Monday to Friday, and approximately 72 h between training sessions from Friday to Monday.

To ensure that all dogs received the same amount of training, regardless of dogs’ varying concentration, speed, etc., the length of all training sessions were defined by an exact number of trials and intertrial intervals, rather than by time, similar to the procedures used in e.g. Rubin et al. (1980). Every training session consisted of 15 training trials, preceded by 3 preliminary trials that were recorded but not used for calculating the success rate. In every trial, the target (the mouse pad) was presented to the dog for approximately 5 s at step 0–2. At step 3, the target was presented for approximately 7 s, leaving the dog a little more time to get to the target. The target was removed from the dog for approximately 5 s between each trial. All data on training were collected by the trainer on data sheets, recording for each training session: the date, time, responses on the three preliminary trials, responses on the 15 training trials, percentage of correct responses (success rate) and comments on the training. Responses on each trial were recorded as correct (any response that was being reinforced with *click + treat*) or incorrect (not receiving *click + treat* within the trial duration period).

All dogs in group 1 started training at the same time. For practical reasons group 2 was divided into two subgroups: one subgroup consisting of 6 dogs (randomly selected) that started training at the same time as group 1, and one subgroup consisting of three dogs that started training, when all dogs in the first subgroup had completed the shaping exercise.

### 2.3. Data analysis

All data were entered in Excel and transferred to SAS 9.1 for statistical analysis. An alpha level of 5% was chosen for all statistical tests. The *t*-test was used to compare the mean number of training sessions to

Table 2  
 Individual results for the dogs: number of training sessions to completion of step 3

Group 1		Group 2	
Dog	Number of sessions	Dog	Number of sessions
47	5	46	6
54	5	82	7
75	5	50	8
59	6	74	8
56	7	62	9
67	7	68	9
64	8	58	10
79	8	49	12
53	9	66	12
Mean	6.66 ± 1.50	Mean	9.00 ± 2.06

completion of training steps 1, 2 and 3 in the two groups. Testing for differences in the mean number of training sessions to completion of step 3 in the two subgroups of group 2 was done using the *t*-test. There was no statistical significant difference between the two subgroups and it was considered reasonable to regard the two subgroups as one. The *t*-test was also used to compare success rates at the different training steps in the two groups. A three-way ANOVA with sex and age as factors and group as repeated factor was performed on the number of sessions to completion of step 3.

### 3. Results

All dogs completed step 3. Table 2 shows the individual results for all dogs. Table 3 summarizes how fast the dogs in the two groups completed the different steps in the shaping exercise. As demonstrated in Table 2 and in Fig. 1, dogs trained once a week (group 1) needed fewer training sessions to complete step 0–3 than dogs trained 5 times a week (group 2). Dogs trained once a week completed the shaping exercise in  $6.7 \pm 1.5$  training sessions, on average.

Table 3  
 Accumulated number of training sessions to completion of a given step

	Minimum	Maximum	Mean ± S.D.	S.E.
Step 0				
Group 1	1	4	2.33 ± 1.11	0.37
Group 2	1	5	3.11 ± 1.69	0.56
Step 1				
Group 1	2	6	3.88 ± 1.36	0.45
Group 2	3	8	5.33 ± 1.87	0.62
Step 2*				
Group 1	3	7	4.88 ± 1.36	0.45
Group 2	4	11	7.22 ± 2.28	0.76
Step 3*				
Group 1	5	9	6.66 ± 1.50	0.50
Group 2	6	12	9.00 ± 2.06	0.69

At steps marked with \* the mean number of sessions in the two groups are significantly different. Group 1: trained once a week. Group 2: trained five times a week.

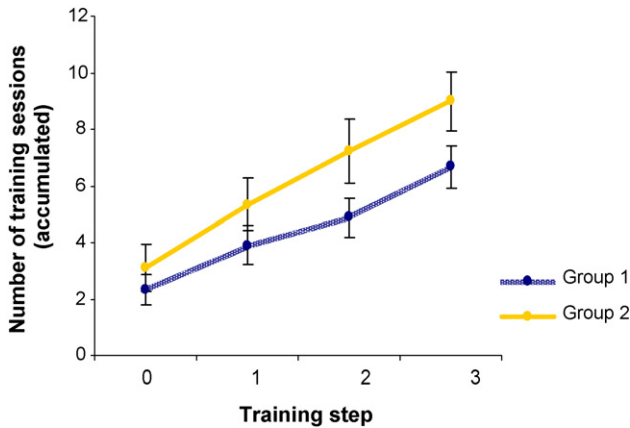


Fig. 1. Number of training sessions to completion of a given step for the two training groups. Vertical lines represent S.D.

Dogs trained 5 times a week completed the shaping exercise in  $9.0 \pm 2.1$  training sessions, on average. This difference is significant ( $P = 0.014$ ).

Group 1 had completed the shaping exercise after  $46.7 \pm 10.5$  days, and group 2 after  $11.4 \pm 2.8$  days. This difference is significant ( $P = 0.001$ ).

When excluding step 0 the data still show the same tendency for dogs in group 1 to complete the shaping exercise in fewer training sessions ( $4.3 \pm 0.7$ ) than dogs in group 2 ( $5.9 \pm 1.2$ ).

Success rates at the four steps of the shaping exercise, measured as the number of correct responses at a given step divided by the total number of responses at that step, are depicted in Fig. 2. The figure illustrates that dogs in group 1 appear to have a better learning performance than dogs in group 2, since the success rate is higher at all steps. Differences in success rate at the different steps are not significant though, except at step 2.

#### 4. Discussion

In the present study dogs trained once a week learned a given shaping exercise in significantly fewer training sessions than dogs trained five times a week. In addition, there seemed to be a

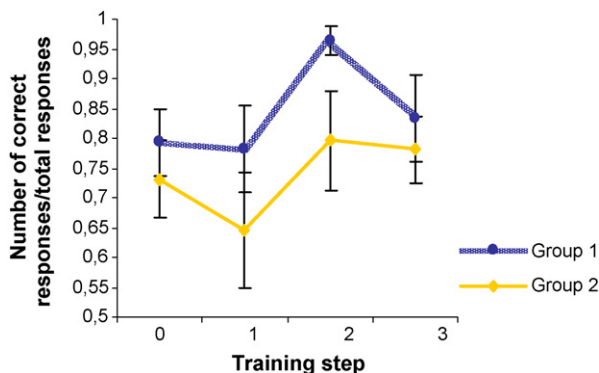


Fig. 2. Success rate at the different steps in the shaping exercise for the two training groups. Vertical lines represent S.D.

tendency for the weekly trained dogs to have higher success rates than dogs trained five times a week at all the steps of the shaping exercise.

It could be argued that dogs trained five times a week would be more affected by the trainer getting used to the training procedures than dogs trained once a week. However, excluding step 0 and thereby excluding data that could have been affected by starting difficulties, data show the same tendency for dogs trained once a week to complete the exercise in fewer training sessions than dogs trained five times a week.

During the introduction to the clicker prior to the training of the shaping exercise it was evaluated that most dogs offered paw lifting responses voluntarily. It was therefore not considered necessary to include this response as a step in the shaping exercise. After the start of the experiment it became obvious that many dogs did not readily lift their paws. One factor that could have influenced the frequency of paw lifting responses is the fact that the dogs were initially reinforced for using their noses to touch the target at step 0. Had all dogs shown a similar reluctance to lift the paw, this response could have been included as part of the shaping exercise. But as it were, including this element as a step in the shaping exercise would have resulted in large variations in the number of training sessions at that step. This variation could have impeded the interpretation of the results in terms of the number of training sessions required to complete the shaping exercise.

The experimental setup of the present study was not blind. The trainer's knowledge about which dogs were trained once or five times a week could have affected the results of the training. To avoid such bias a very standardized exercise with detailed training manuals was used and the criteria for correct responses were well defined.

The results of the present study are in accordance with results presented by [Rubin et al. \(1980\)](#), who found that weekly training of horses resulted in better learning performance than daily training. In contrast, [Kusunose and Yamanobe \(2002\)](#) have shown that horses trained daily perform better than horses trained 4 days a week with a 3 days rest interposed. In their study it appears that each training session had a desired learning objective and that the horses moved on to something else during the following training sessions independently of their performance on the daily training session. It is thus the overall training that is being repeated either daily or with resting periods interposed, and not the training of a specific skill. Because of this difference and possibly because of a lower level of control over factors that can affect the learning performance, it is difficult to compare their results with the results of [Rubin et al. \(1980\)](#) and the present study. It is important to emphasize that the present study did not investigate whether dog training should involve daily training or training several times a week, but rather whether learning performance on a specific exercise is affected by the number of times it is being trained in a week.

The present study supports findings that weekly training of a given skill is better than daily training, in terms of the number of training sessions required to reach a certain training level. Studies on rats have demonstrated a spacing effect in relation to training schedules involving much shorter inter-session intervals ([Commins et al., 2003](#); [Spreng et al., 2002](#)). According to [Wozniak et al. \(1995\)](#), the optimum inter-repetition interval is likely to be the longest interval that avoids retrieval failures; i.e., as long as the animal does not completely forget what has been learned on the previous training session, longer intervals between training sessions lead to better learning performance. It is reasonable to assume that an optimal inter-repetition interval depends on both the task to be learned and the species being studied, and hence studies differing in regards to species, learning objective, and temporal spacing might still be comparable.

Several studies have shown that spaced training benefits long-term retention ([Commins et al., 2003](#); [Kogan et al., 1996](#); [Menzel et al., 2001](#); [Rowe and Craske, 1998](#); [Spreng et al., 2002](#)). Even

though the present study did not include a test of long-term retention after the dogs had completed the exercise it did measure some degree of long-term memory in the dogs, since memories lasting longer than a day are considered intermediate or long-term memory (Rosenzweig et al., 1996). Different aspects of memory consolidation might contribute to a possible advantage of spaced training schedules. The amount of activities between training sessions might influence the learning ability in the two groups of dogs. Practicing several skills at a time can have a positive influence on learning performance. This mechanism is known as contextual interference (Lee et al., 1991; Maslovat et al., 2004). In the present study contextual interference could be a contributing factor to the higher learning performance of dogs trained weekly compared to dogs trained five times a week, since the weekly trained dogs have probably been subject to a greater degree of interference from other training. Similarly, Williams and Johnston (2002) have shown that dogs trained to detect different odors, tended to perform better the more odor discriminations (up to 10) the dogs were taught, both when learning new odors and when refreshing previously learned odors.

Another possible difference between the two training groups of the present study is the degree to which the dogs habituated to the training environment and the trainer. Differences in degree of habituation between spaced and massed training have been shown in rats (Commins et al., 2003). The authors argue that the spaced training inhibit the habituation to the training environment and instead cause the rats to renew their exploration on every trial thereby building a better spatial representation. This could explain why the performance of rats trained on a spaced training schedule is superior to performance of massed trained rats in spatial learning tasks like the Morris Water Maze. Even though the dogs in the present study were not learning a spatial task, habituation might still be an important factor. Caused by a lower level of habituation to the training procedure, the weekly trained dogs might have been poorer at predicting the outcome of every trial in the training sessions. Behavior that is followed by positive consequences, exceeding expected outcomes, is strongly reinforced, whereas responses followed by outcomes that are well predicted, result in less learning (Rescorla and Wagner, 1972). Consequently, the weekly trained dogs might have received many more jackpots than the dogs trained five times a week. If the weekly trained dogs in the present study habituated less to the training environment and the trainer, it could also be suggested that the training environment was more variable for the weekly trained dogs than for the dogs trained five times a week. This variability in training environment may have caused a greater degree of generalization in the weekly trained dogs, thereby making them less sensitive to small changes in the training situation, like a new odor or a table placed differently. It could also be speculated that the variable training environment resulted in a greater degree of variability in the responses of the dogs, preventing them from staying locked in the first response that was reinforced. On the other hand, a reduced level of habituation could also result in the weekly trained dogs having a harder time concentrating on the training because of distraction from an unfamiliar environment. The trainer did not record a tendency for the weekly trained dogs to be more exploring or less concentrated in the training room. A lower level of habituation in the weekly trained dogs may also have caused a higher level of arousal in the training situation for these dogs, compared to the dogs trained five times a week. A moderate state of arousal seems to be optimal for memory formation (Rosenzweig et al., 1996), and a higher level of arousal in the weekly trained dogs compared to the dogs trained five times a week might have contributed to the increased performance in these dogs. Nothing can be learned under conditions of excessive stress, though (Lindsay, 2000), and consequently too much stress caused by training in unfamiliar environments can result in decreased learning performance.

## 5. Conclusion

Dogs trained once a week completed a certain shaping exercise in significantly fewer training sessions than dogs trained five times a week. In addition, the weekly trained dogs tended to have higher success rates than dogs trained five times a week. Evaluating different studies involving the effect of training schedules on learning performance, it is suggested that the optimal inter-repetition interval depends on both the task to be learned and the species being trained. Possible factors which may influence the results of the present study are: the time that elapses between training sessions, the amount of activities between training sessions, the degree of habituation of the dogs to the training environment, and procedures and the level of arousal in the training situation. It is concluded that for dogs learning a given skill, weekly training results in better learning performance than training five times a week, when performance is measured in the number of training sessions required to reach a certain training level.

## Acknowledgements

We would like to thank Lundbeck A/S for placing dogs and locations at disposal for this study, and the personnel at Lundbeck, Vestermarksgaard for helping out during the execution of the experiment. We thank Liza Rosenbaum Nielsen and Tina Birk for support on statistical matters.

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